Passive Autonomous Acoustic Monitoring of Marine Mammals: System Development Using Seaglider™

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LONG-TERM GOALS

This effort exists within a group dedicated to the use of autonomous underwater vehicles, and buoyancy-driven gliders in particular, to support Navy missions. The group generally uses the Seaglider™, developed at the Applied Physics Laboratory of the University of Washington (APL-UW), and develops or adapts instruments and glider behavior to support specific mission requirements. This group is informally called the Applied Seaglider™ Group, whose acronym, ASG, is also used to describe the Applied Seaglider™itself.

This report describes ongoing efforts as part of the ONR Passive Autonomous Acoustic Monitoring (PAAM) program. The long-term goals of the PAAM program are as follows:

- Perform persistent and autonomous passive acoustic monitoring of a 500-1000 square nautical mile Navy exercise area for presence of marine mammals.
- Monitor for three weeks prior to, three weeks during, and three weeks after a typical exercise.
- Detect, classify and localize vocalizing marine mammals.
- Provide actionable information in a timely manner to the officer in tactical command to support marine mammal mitigation efforts.

OBJECTIVES

With previous ONR funding (N00014-08-1-0309), we have enhanced the passive acoustic detection, recording, and on-board processing capabilities of Applied Seaglider™ (ASG), with particular attention to the automated detection and classification of beaked whale vocalizations. In particular, we have designed and built a new passive acoustic detection and recording system for ASG, and tested this system in the field several times.

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The objectives of this program are to enhance detection and classification performance with multiple hydrophones or small hydrophone arrays, improve the automated detection and classification (software) components, and successfully demonstrate the system in a Navy fleet exercise.

APPROACH

The program will continue to focus on automated detection, classification, and recording of beaked whale vocalizations.

Our approach is as follows:

- Treat the single-hydrophone PAAM electronics system as deployed at AUTEC in June, 2010 as a baseline.
- Continue to collaborate with Drs. David Mellinger and Holger Klinck at Oregon State University (OSU) on improved beaked whale detection and classification algorithms.
- Test installation of second omni-directional hydrophone to minimize signal obstruction by the Seaglider™ pressure hull.
- Collaborate with Ocean Acoustical Services and Instrumentation Systems (OASIS), Inc. on the integration of an L3 Chesapeake Sciences Mills cross high-frequency array.

Key participants at APL-UW, in addition to the Principal Investigators listed above, are Bill Jump (hardware and system design engineer), Geoff Shilling (software engineer), Trina Litchendorf (ASG Lab), and Angie Wood (ASG Lab). David Mellinger and Holger Klinck at OSU provide detection and classification algorithms. Phil Abbot, Chuck Gedney, and Dave Morton at OASIS, Inc., collaborate on the Mills cross hydrophone array, fabricated by L3/Chesapeake Sciences Corporation.

WORK COMPLETED

Initial program planning is complete. Non-disclosure agreements are in place between the University of Washington (UW) and L3/Chesapeake Sciences Corporation which allow APL-UW to release Seaglider™ engineering drawings licensed by the UW to iRobot Corporation.

An initial round of design discussions have been held with OASIS, Inc. personnel regarding integration of their array telemetry and recorder and signal processing packages.

Initial hardware and software modifications were started to incorporate a second omni-directional hydrophone into the standard Seaglider™ PAAM single-hydrophone configuration. This modification will be tested on one Seaglider™ in an upcoming marine mammal mission.

RESULTS

Due to the extremely long time required to establish the relevant non-disclosure agreements, and hence exchange initial technical information between the relevant engineering staffs at the participating organizations, no lab or field results of the technology development or test program can be reported.

Initial discussions were held, by telephone and email, between engineers at APL-UW and OASIS. APL-UW communicated the payload integration constraints imposed by Seaglider™: size, weight, power consumption, and integration into the command, control, and data telemetry system. It is clear that the existing OASIS hardware (TARR, FPGA signal processor, etc.) exceeds the limitations imposed by the Seaglider™ in almost every way. The next round of engineering discussions will focus on two tracks: the ability of OASIS to use existing Seaglider™ PAAM hardware to meet their needs, and the feasibility of a redesign of the OASIS hardware to fit within the Seaglider™ constraints.

We plan to have both a two-hydrophone and a Mills cross array version of the Seaglider™ PAAM system available for at-sea testing by summer, 2011, and fully implemented for a Navy fleet demonstration planned in FY2012.